PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-226676
(43)Date of publication of application : 03.09.1993

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(51)Int.Cl.
H01L 31/0232
H01L 21/56
H01L 31/02
H01L 33/00

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(21)Application number : 04-027966
(22)Date of filing : 14.02.1992
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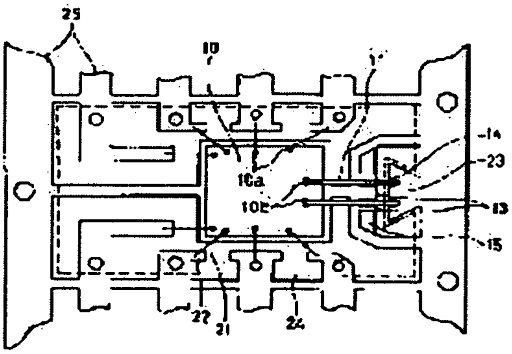
(54) SEMICONDUCTOR DEVICE



(57)Abstract:

PURPOSE: To establish good connection with an optical signal cable in a semiconductor device where at least one of a light emitting or a light receiving element is sealed with resin together with an optical signal wire.

CONSTITUTION: A semiconductor chip 10 is formed comprising an electrical signal processing circuit and a light receiving element with inclusion of a bonding pad 10b of an optical signal. A lead frame 25 is provided with a groove consisting of the

U-shaped cutting pattern 13 at the position facing a wire 11 for an optical signal. The wire 11 for optical signal reaches a side rail 23 along the cutting pattern 13 for the bonding to the predetermined position. Moreover, a film 15 such as polyimide or the like with bonding agent is previously attached to the cutting pattern 13 at the surface of lead frame 25 in the opposite side of the bonding surface of the wire 11 for optical signal.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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[Claim(s)]

[Claim 1] The semi-conductor substrate which has either [at least] a photo detector or a light emitting device, and the package body which closes this semi-conductor substrate, The leadframe in which said semi-conductor substrate was attached in the interior of this package body, It has the wire for lightwave signals with which the end is connected to said semi-conductor substrate in the interior of said package body, and the other end was drawn by the exterior of said package body. The semiconductor device characterized by establishing a fixed means to fix said wire for lightwave signals to said leadframe that said wire for lightwave signals should be positioned to said package body.

[Claim 2] Said fixed means is a semiconductor device according to claim 1 characterized by including the film with a binder which it is stuck on a part for the slot of said leadframe in order to cover an opposite [inserted / said wire for lightwave signals] side to the slot in which it is formed in said leadframe and said wire for lightwave signals was inserted, and said slot, and said wire for lightwave signals pasted up into said slot.

[Claim 3] The semi-conductor substrate which has either [at least] a photo detector or a light emitting device, and the package body which consists of mold resin and closes said semi-conductor substrate, The leadframe in which said semi-conductor substrate was attached in the interior of this package body, It has the wire for lightwave signals with which the end is connected to said semi-conductor substrate in the interior of said package body, and the other end was drawn by the exterior of said package body. The semiconductor device characterized by being covered by the resin by which the perimeter of the derivation location of said wire for lightwave signals does not contain a hard bulking agent.

[Detailed Description of the Invention]

[0001]

[Industrial Application] About a semiconductor device, especially this invention has either [at least] a light emitting device or a photo detector, and relates to the semiconductor device which closed with resin etc. the semi-conductor substrate which can process an electric signal and a lightwave signal, and constituted it with the wire for lightwave signals required for the communication etc.

[0002]

[Description of the Prior Art] There is a semiconductor device of a plastic molded type as a kind of a semiconductor device which carried out packaging of the semi-conductor substrate constituted as a semiconductor chip which generally has

IC (integrated circuit) component, a light emitting device, a photo detector, etc., and manufactured it. This semiconductor device is carrying out the resin seal of the semi-conductor substrate attached on the leadframe with the wire for lightwave signals which made predetermined optical connection to this so that it not only can process an electric signal, but a lightwave signal can be processed.

[0003] This kind of the structure and the manufacture approach of a semiconductor device are explained with reference to drawing 7 . Drawing 7 shows the internal structure of this kind of semiconductor device in the condition in that one production process.

[0004] In drawing 7 , the semiconductor chip 50 which is an example of a semi-conductor substrate is attached on the die pad of a leadframe 55. The wire 61 for electrical signals is bonding pad 50a for electrical signals formed on the semiconductor chip 50. Connection is carried out between the terminal sections 62 of a leadframe 55.

[0005] On the other hand, the wire 51 for lightwave signals is bonding pad 50b for the lightwave signals of the light emitting device which a semiconductor chip 50 has, or a photo detector. Connection is carried out between the side-rail sections 63 of a leadframe 55. In addition, the side-rail section 63 will be located in the exterior of a package body at the time of assembly completion of equipment, and will be separated from a package body.

[0006] After carrying out wirebonding of the wires 51 and 52 in this way, a package body with the package side face 64 which the transfer mold molding closure of the member of these semiconductor chips 50, a wire 51, and 52 grades is carried out with an epoxy resin etc., namely, is shown by the drawing destructive line is formed. Furthermore, in the exterior of this package body, cutting formation of the external terminal is carried out by the leadframe 55, and surface treatment for soldering is performed to this.

[0007] Thus, in case the produced package is separated from the side-rail section 63 of a leadframe 55, the wire 51 for lightwave signals will be cut near the front face of the package side face 64.

[0008] Then, polish processing of the wire 51 for lightwave signals in the package resin front face equivalent to the board thickness of the leadframe 55 of a metal mold parting surface is carried out with the resin on the front face of a package, it graduates so that the optical connection with the optical fiber cable for external connection can be taken, and assembly processing of a semiconductor device is completed.

[0009]

[Problem(s) to be Solved by the Invention] Generally, in this kind of semiconductor device, it is important to raise more the stability about communication of a lightwave signal and dependability. Therefore, in case the cable for lightwave signals used for the optical connection between two or more semiconductor devices and each semiconductor device are connected, it is necessary to carry out exact positioning among both, and, for this reason, it becomes very important to derive the wire for lightwave signals to the position on the front face of a package of a semiconductor device.

[0010] However, according to the Prior art mentioned above, there is no suitable positioning means of the wire 51 for lightwave signals inside a package. For this reason, the derivation location in the package front face of the wire 51 for lightwave signals shifts from a predetermined derivation location, or the include angle of the wire 51 for lightwave signals to a polished surface shifts. Consequently, when the cable for lightwave signals was connected to a semiconductor device, the optical-axis gap occurred between the cable for lightwave signals, and the wire for lightwave signals, and there was a trouble that the case where the normal flow of a lightwave signal is not securable will arise.

[0011] Moreover, the above-mentioned ground region by which surface polish is carried out is covered by transfer mold resin, and the silica powder contained in resin existed the wire for lightwave signals also in the perimeter of a derivation location. For this reason, in a manufacture phase, the silica powder which is a bulking agent in resin became the hindrance of smooth polish processing in the polished surface-ed at the time of surface polish of the predetermined wire derivation location for lightwave signals on said front face of a package, consequently the manufactured semiconductor device was carried out, and there was also a trouble that good connection could not be optically made with the cable for lightwave signals.

[0012] This invention is made in view of the conventional trouble mentioned above, and let it be a technical problem to offer the semiconductor device which can accomplish connection with the cable for lightwave signals good.

[0013]

[Means for Solving the Problem] The semi-conductor substrate which has either [at least] a photo detector or a light emitting device in order that the semiconductor device of the 1st invention of this application may attain an above-mentioned technical problem, The package body which closes this semi-conductor substrate, and the leadframe in which the semi-conductor substrate was attached in the interior of this package body, It has the wire for lightwave signals with which the end is connected to the semi-conductor substrate in the interior of a package body, and the other end was drawn by the exterior of a package body. It is characterized by establishing a fixed means to fix the wire for lightwave signals to a leadframe that the wire for lightwave signals should be positioned to a package body.

[0014] Moreover, the semi-conductor substrate which has either [at least] a photo detector or a light emitting device in order that the semiconductor device of the 2nd invention of this application may attain an above-mentioned technical problem, The package body which consists of mold resin and closes a semi-conductor substrate, The leadframe in which the semi-conductor substrate was attached in the interior of this package body, It has the wire for lightwave signals with which the end is connected to the semi-conductor substrate in the interior of a package body, and the other end was drawn by the exterior of a package body, and is characterized by being covered by the resin by which the perimeter of the derivation location of the wire for lightwave signals does not contain a hard bulking agent.

[0015]

[Function] Generally, the factor from which the wire for lightwave signals starts the location gap from the predetermined derivation location on the front face of a package and the include-angle gap with a package polished surface is that are pushed on resin and bonding loop shape mainly deforms at the time of the vibration and the resin seal in a back process when bonding of the wire for lightwave signals is carried out, and the bonding loop shape of the wire for lightwave signals lacks in repeatability.

[0016] Since it was made to fix to a leadframe that the wire for lightwave signals with which the end is connected to the semi-conductor substrate in the interior of a package body, and the other end was drawn by the exterior of a package body should be positioned to a package body here with a fixed means according to the 1st invention of this application, it becomes possible to derive the wire for lightwave signals to the position of a package book body surface. Consequently, positioning required for connection with the wire for lightwave signals and the cable for lightwave signals which were drawn from the package can be performed correctly, and optical connection with the cable for lightwave signals can be made good.

[0017] In addition, the slot in which it is formed in the leadframe and the wire for lightwave signals was inserted in the 1st invention, If a fixed means is constituted from a film with a binder which it is stuck on a part for the slot of a leadframe, and was pasted up into the wire fang furrow for lightwave signals in order to cover a slot from an opposite [inserted / the wire for lightwave signals] side Since it can tacking carry out of the wire for lightwave signals to a predetermined location in case the resin seal of the semiconductor device concerned is carried out, it can simplify and very exact positioning can be carried out.

[0018] According to the 2nd invention of this application, moreover, a package body Since it consists of mold resin containing a hard bulking agent etc., a semi-conductor substrate can be closed good physically. On the other hand Since the perimeter of the derivation location of the wire for lightwave signals with which the end is connected to the semi-conductor substrate in the interior of a package body, and the other end was drawn by the exterior of a package body is covered by the resin which does not contain a hard bulking agent In the manufacture phase, smooth polish processing which does not damage a polished surface-ed with the silica powder in mold resin etc. at the time of polish near the derivation location of the wire for lightwave signals in the front face of a package body is attained. Consequently, optical connection with the cable for lightwave signals can be made good.

[0019] From the example of this invention shown below, such an operation of this invention will be clarified more and other operations of this invention will be clarified further.

[0020]

[Example] The example of this invention is explained to a detail using a drawing below.

[0021] First, the structure and the manufacture approach of a semiconductor device of this example are explained with reference to drawing 1 . Drawing 1 shows the internal structure of the semiconductor device of this example in the condition in the one production process.

[0022] It is bonding pad 10a for an example slack semiconductor chip 10 of a semi-conductor substrate being constituted in drawing 1 including the processing circuit and light emitting device, or photo detector of an electric signal inside, and communicating an electric signal in the front face. Bonding pad 10b for communicating a lightwave signal It has. The semiconductor chip 10 is attached on the die pad of a leadframe 25 by the adhesives of for example, a silver epoxy system.

[0023] The leadframe 25 consists of ingredients, such as a copper system or 42 alloys, and silver plating is beforehand given to the part by which bonding of the golden wire 21 is carried out to a leadframe 25.

[0024] Electrode pad 10a of a semiconductor chip 10 Connection of the terminal area 22 of a leadframe 25 is carried out with the golden wire 21 using the nail head bonding technique which used the supersonic wave together.

[0025] The wire 11 for lightwave signals consists of plastics of the flexibility for optical transmissions etc. Bonding pad 10b of the light emitting device which a semiconductor chip 10 has, or a photo detector Connection of the side-rail section 23 of a leadframe 25 is carried out with the wire 11 for lightwave signals for example, using the nail head bonding technique. Thus, the wire 11 for lightwave signals optically connected with this light emitting device or the photo detector is drawn in the package exterior.

[0026] The side-rail section 23 will be located in the exterior of a package body after assembly completion of equipment, and will be separated from a package body.

[0027] in order [in addition,] to secure bonding nature with a wire 11 -- bonding or before -- beforehand -- a semiconductor chip 10 side and a leadframe -- it may be made to perform coating processing by the good film of a leadframe 25 and adhesion in a wire 11, bonding pad 10b, and a list in both bonding area-ed sides 25 side. In this case, if it is a function, in order to close a light emitting device or a photo detector, the coating film with translucency must be used for a semiconductor chip 10 side at least. Moreover, as coating film with this translucency, although the organic film of the translucency of acrylic resin etc. may be used, it is especially whenever [stoving temperature / in the case of bonding] in this case. It is desirable to carry out below 100 degrees C.

[0028] Moreover, in order to face carrying out bonding of the wire 11 for lightwave signals to a semiconductor chip 10 and to prevent oxidization deterioration of the wire 11 by heating, it is desirable by irradiating the energy of a laser beam, where inert gas is blown upon the ball formation part of the tip region of a wire 11, and carrying out heating fusion of the wire 11 to form a wire ball.

[0029] Here, especially in this example, the slot which consists of a character type slitting pattern 13 of KO which constitutes an example of a fixed means is established in the location which meets the wire 11 for lightwave signals at the leadframe 25.

[0030] As shown in drawing 1 and drawing 2 , they are the wire 11 for lightwave signals, and bonding pad 10b. After completing the bonding of a between, the wire 11 for lightwave signals results in the side-rail section 23 along with the slitting pattern 13 of the typeface of KO formed for wire positioning, and bonding to a position is performed.

[0031] Therefore, at this example, after carrying out bonding of the wire 11 for lightwave signals on both sides of the wire 11 for lightwave signals by the leadframe 25 from both sides, the wire 11 for lightwave signals moves, and it consists of processes so that a location gap and the include-angle gap to a polished surface may not be carried out from the position of a package book body surface.

[0032] In addition, especially in this example, the slitting pattern 14 of the typeface of KO is formed also in the side-rail section 23 separated from a package after assembly completion for wire positioning. For this reason, this wire positioning can be performed more to accuracy.

[0033] Moreover, he is trying to stick the films 15, such as polyimide with a binder, on the bonding side of the wire 11 for lightwave signals, and the field of the leadframe 25 of the opposite side beforehand to the slitting pattern 13 of the typeface of KO in a package further in this example before bonding. This can perform eye **** of the wire 11 for lightwave signals in a manufacture phase with the slot of the slitting pattern 13 of the typeface of KO of a leadframe 25, and the film 15 with a binder.

[0034] Thus, much more stabilization of wire loop shape can be attained by setting up wire bond conditions so that some wires 11 for lightwave signals may contact the adhesion film 15 in this slot.

[0035] Moreover, the light transmitted in the inside of the wire 11 for lightwave signals begins to leak from a wire side face to the wire 11 for lightwave signals used, and coating of the wire lateral portion is uniformly carried out with the coat which reflects light so that light may not decline.

[0036] thus, the resin 16 which does not contain the hard bulking agent which serves as trouble at polish of silica powder etc. in the perimeter of the derivation part 12 of the wire 11 for lightwave signals of this slot as shown in drawing 2 R> 2 and drawing 3 after bonding termination, for example, the epoxy resin which does not contain the hard flour exceeding the diameter of 1 micron, -- potting -- and it heat-hardens. That is, the perimeter of the wire 11 for lightwave signals will be covered by this resin 16 to make it transfer mold resin 17 not reach a ground region at a subsequent closure process.

[0037] Then, it casts by the transfer mold resin of an epoxy system, and the closure is completed, while performing cutting molding of an external terminal further, surface preparation for the soldering is performed and packaging is carried out. Under the present circumstances, in case a package is separated from the side-rail section 23 of a leadframe 25, the wire 11 for lightwave signals is cut near the front face of the package side face 24.

[0038] Then, specified quantity (for example, several 10 microns) mechanical polishing of the wire 11 for lightwave signals shown in the package resin front face equivalent to the board thickness of the leadframe 25 of the metal mold parting surface 26 as shown in drawing 4 is carried out with the resin on the front face of a package, and irregularity is the depth 0.5. The polished surface 18-ed [smooth side slack] of micron extent is formed. Here, since this resin part ground consists of resin 16, a polish front face is not damaged. Consequently, the good optical connection with the optical fiber cable for external connection can be taken now.

[0039] The semiconductor device 31 constituted as a semiconductor package as shown in drawing 5 as mentioned above is completed.

[0040] Along with the periphery section, it has the outer lead 33 for communicating an electric signal, and the derivation part 12 of the wire 11 for lightwave signals has exposed the semiconductor device 31 in a polished surface from the package body so that drawing 5 may show.

[0041] Thus, after the constituted semiconductor device 31 is carried in a printed circuit board etc., as shown in drawing 6 , it connects with the optical cable 41 which the connector 40 is formed and consisted of optical fibers etc., and connection of it is carried out to other semiconductor devices through this optical cable 41.

[0042] Under the present circumstances, since according to this example the derivation part 12 of the wire 11 for lightwave signals is positioned correctly and a blemish has hardly arrived at the polished surface 18-ed on the front face of a package, optical connection with an optical cable 41 can be made very good.

[0043]

[Effect of the Invention] Since it was made to fix to a leadframe that the wire for lightwave signals drawn by the exterior of a package body should be positioned to a package body with a fixed means according to the 1st invention of this application as explained to the detail above, it becomes possible to derive the wire for lightwave signals to the position of a package book body surface. Consequently, positioning required for connection with the wire for lightwave signals and the cable for lightwave signals which were drawn from the package can be performed correctly, and optical connection with the cable for lightwave signals can be made good.

[0044] Moreover, since the perimeter of the derivation location of the wire for lightwave signals drew by the exterior of a package body be cover by the resin which do not contain a hard bulking agent according to the 2nd invention of this application, at the time of polish near the derivation location of the wire for lightwave signals in the front face of a package body, smooth polish processing which do not damage a polished surface-ed with the silica powder in mold resin etc. be attain, and optical connection with the cable for lightwave signals can be make good.

[0045] While being able to process both an electric signal and a lightwave signal by this invention the above result, lessons is taken from the both and extremely stable and very reliable communication is enabled, it excels in mass-production nature, and a cheap semiconductor device can be realized.

[Brief Description of the Drawings]

[Drawing 1] It is the top view having shown the internal structure of the semiconductor device of one example of this invention in the condition in the one production process.

[Drawing 2] It is the fragmentary sectional view showing near the derivation section of the wire for lightwave signals of the example of drawing 1 .

[Drawing 3] It is the top view having shown the internal structure of the example of drawing 1 in the condition in other production processes.

[Drawing 4] It is the side elevation showing near the derivation section of the wire for lightwave signals of the example of drawing 1 .

[Drawing 5] It is the perspective view showing the completion condition of the example of drawing 1 .

[Drawing 6] It is the perspective view showing the condition of having connected the optical cable of the example of drawing 6 .

[Drawing 7] It is the top view having shown the internal structure of the semiconductor device of the conventional example in the condition in the one production process.

[Description of Notations]

10 Semiconductor Chip
11 Wire for Lightwave Signals
12 Wire Derivation Part for Lightwave Signals
13 Slitting Pattern of Typeface of KO in Package
14 Slitting Pattern of Typeface of KO of Side-Rail Section
15 Adhesion Film
16 POTINGU Resin Which Does Not Contain Hard Filler
17 Transfer Mold Resin
18 Ground Region on Front Face of Package
21 Golden Wire
22 Terminal Section of Leadframe
23 Side-Rail Section of Leadframe
24 Package Side Face Cast by Mold Resin
25 Leadframe
26 Metal Mold Parting Surface

31 Semiconductor Device
40 Optical Cable Connector
41 Optical Cable